CLAIMS

What is claimed is:

1. A projection display comprising an optical modulator to modulate a light beam radiating from an illumination unit according to image data and projection optics to magnify and project the light beam emitted from the optical modulator, the illumination unit comprising:

three integrator modules that radiate red, green, and blue beams, respectively, with a uniform intensity of light,

wherein each of the three integrator modules comprises,

at least one compact light source, and

a glass rod that transforms a light beam emitted from the at least one compact light source so as to have a uniform light intensity and emits the transformed light beam, and that comprises an incident portion through which the light beam radiates and an emission portion through which the light beam is emitted; and

wherein the incident portion comprises a parabolic first reflective surface to collimate the light beam radiating from the at least one compact light source, and the at least one compact light source is located in the vicinity of a focal point of the first reflective surface.

2. The projection display of claim 1, wherein at least one of the three integator modules comprises an aperture with an aspect ratio equal to an aspect ratio of an aperture of the optical modulator.

3. The projection display of claim 1, wherein at least one of the three integrators comprises an aperture with a predetermined size equal to a size of the aperture of the optical modulator.

4. The projection display of claim 1, wherein the at least one compact light source is arrayed so that an optical axis of the at least one compact light source is perpendicular to a principal axis of the first reflective surface.

5. The projection display of claim 1, wherein the incident portion further comprises a second reflective surface which faces the first reflective surface and comprises an optical window through which the light beam radiates from the at least one compact light source.

6. The projection display of claim 1, wherein the second reflective surface inclines with respect to the principal axis of the first reflective surface at a predetermined incidence angle, and the at least one compact light source is arrayed so that an optical axis of the at least one compact light source inclines with respect to the principal axis at the same angle as the predetermined incidence angle as the second reflective surface.

7. The projection display of claim 1, wherein the optical modulator is a reflective optical modulator, and the illumination unit further comprises relay optics which guides the light beam emitted from the at least one of the three integrator modules toward the reflective optical modulator.

8. The projection display of claim 7, wherein the at least one of the three integrator modules comprises an aperture with an aspect ratio equal to an aspect ratio of an aperture of the optical modulator, and the relay optics magnifies or reduces the light beam emitted from the at least one of the three the integrator modules so that the light beam is incident on the reflective optical modulator.

9. The projection display of claim 7, wherein the at least one of the integrator modules comprises an aperture equal to an aperture of the reflective optical modulator, and the relay optics adjusts the light beam emitted from of the at least one of the integrator modules with respect to the aperture of the reflective optical modulator at a magnifying power of 1:1.

10. The projection display of claim 7, wherein the illumination unit further comprises a $\lambda/4$ plate and a polarizing beam splitter which transmits one of P and S waves and reflects the other one of the P and S waves, the $\lambda/4$ plate and the reflective optical modulator being located in one of a transmission direction and a reflection direction so that one of the P and S waves is modulated by the reflective optical modulator and then incident on the projection optics.

11. The projection display of claim 7, wherein the illumination unit further comprises a $\lambda/4$ plate and a polarizing beam splitter which transmits one of P and S waves and reflects the other one of the P and S waves, the $\lambda/4$ plate and the reflective optical modulator being located in a transmission direction and a reflection direction, respectively, so that the P and S waves are modulated by the reflective optical modulator and then incident on the projection optics.

12. A projection display comprising:

one or more integrator modules that emit a light beam with a uniform intensity of light;

a digital micromirror device that modulates the light beam according to image data;

projection optics that magnifies and projects the light beam emitted from the digital micromirror device; and

a total internal reflection prism that guides the light beam emitted from the one or more integrator modules toward the digital micromirror device and the light beam emitted from the digital micromirror device toward the projection optics,

wherein the one or more integrator modules comprise,

at least one compact light source, and

a glass rod that transforms a light beam emitted from the at least one compact light source to have a uniform light intensity and emits the modulated light beam, and comprises an incident portion through which the light beam radiates and an emission portion through which the light beam is emitted; and

wherein the incident portion comprises a parabolic first reflective surface to collimate the light beam radiating from the at least one compact light source, and the at least one compact light source is located in the vicinity of a focal point of the first reflective surface.

13. The projection display of claim 12, wherein:

the one or more integrator modules comprise:

three integrator modules that emit red, green, and blue beams, respectively; and

the projection display further comprises:

an optical path changer that guides the red, green, and blue beams emitted from the three integrator modules toward the total internal reflection prism.

14. The projection display of claim 12, wherein the one or more integrator modules comprise an aspect ratio equal to an aspect ratio of an aperture of the digital micromirror device.

15. The projection display of claim 12, wherein the one or more integrator modules comprise an aperture with a predetermined size equal to a size of the aperture of the digital micromirror device.

16. The projection display of claim 12, wherein the at least one compact light source

is arrayed so that an optical axis of the at least one compact light source is perpendicular to a main axis of the first reflective surface.

17. The projection display of claim 12, wherein the incident portion further comprises a second reflective surface which faces the first reflective surface and comprises an optical window through which the light beam radiates from the at least one compact light source.

18. The projection display of claim 12, wherein the second reflective surface inclines with respect to a principal axis of the first reflective surface at a predetermined incidence angle, and the at least one compact light source is arrayed so that an optical axis of the at least one compact light source inclines with respect to the principal axis at the same angle as the predetermined incidence angle as the second reflective surface.

19. An integrator module having a light source and used with a projection display, comprising:

a glass rod having an incident portion to transform a light beam emitted from the light source, and an emission portion to emit the transformed light beam substantially in a principal axis of the glass rod,

wherein the incident portion comprises a first reflective surface and a second reflective surface to reflect a first portion of the light beam emitted from the light source and to reflect a second portion of the light beam reflected by the first reflective surface, respectively, and the light source is disposed at a focal point of the first reflective surface.

20. The integrator module of claim 19, wherein the first reflective surface is a parabolic surface, and the second reflective surface is a flat surface having a portion disposed on the focal point of the first reflective surface.

21. The integrator module of claim 19, further comprising:

a rod portion disposed between the incident portion and the emission portion in a direction parallel to the principal axis to transmit the first portion of the light beam reflected by the first reflective surface and the second portion of the light beam reflected by the second reflective surface to the emission portion substantially in a direction parallel to the principal axis.

22. A projection display having a light source, comprising:

an integrator module comprising a glass rod having an incident portion to transform a light beam emitted from the light source, and an emission portion to emit the transformed light beam substantially in a principal axis of the glass rod;

an optical modulator to modulate the light beam emitting the emission portion of the glass rod according to image data; and

projection optics to magnify and project the light beam emitted from the optical modulator,

wherein the incident portion comprises a first reflective surface and a second reflective surface to reflect a first portion of the light beam emitting from the light source and to reflect a second portion of the light beam reflected by the first reflective surface, respectively, and the light source is disposed at a focal point of the first reflective surface.